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COMMUNICATION CONTROL METHOD, COMMUNICATION METHOD, SERVER APPARATUS, TERMINAL DEVICE, RELAY APPARATUS AND COMMUNICATION SYSTEM

5   BACKGROUND OF THE INVENTION

                        TECHNICAL FIELD

        The present invention relates to a communication
10   control method, communication method, server apparatus,
      terminal device, relay apparatus and communication system
      suitable for use in an information distributing system
      providing information from at least one server apparatus to
      a plurality of user terminals via a network.
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                        BACKGROUND ART

        The internet provides content providers with an
      environment capable of providing content to users around
20   the world directly and at a low cost, and provides users an
      environment enabling content from around the world to be
      used in a standard user interface. Along with the
      popularization of the internet, recent years have seen
      active development, provision and use of content providing
25   services making use of the internet, and the vast amount of
      content for various uses on the internet is increasing
      daily. As a result, the ease of access to the internet has
      become an important consideration in the development of
      content distributing services.
30   With the spread of the internet, transparent system
      architectures employing internet technologies in LANs
      (Local Area Networks) have become commonplace. Here, one
      basic constituent of "internet technologies" is the

communication protocol, specifically TCP/IP (Transmission Control Protocol / Internet Protocol). That is, a very large number of networks currently employ the TCP/IP.

Data communications according to TCP/IP are based on an OSI layer model (OSI Reference Model) wherein, on the transmission side, data is relayed by adding headers for each layer onto actual data from a higher layer to a lower layer, and packets are transmitted to the reception side. On the other hand, at the reception side, the transmitted packets are handed from the lowest physical layer in order to the highest layer. During this procedure, in each layer, packets supplied from a lower layer are separated into data and a header corresponding to that layer, the content of this header is analyzed, and the data is handed to a higher layer.

Here, the packet structure obtained by the processing in each layer on the transmission side shall be explained with reference to Figs. 12-14. However, it shall here be assumed that, as in general dial-up connections, the transmission side and reception side are connected one-to-one using a PPP (Point-to-Point Protocol).

Fig. 12 shows the structure of a TCP segment which is a packet that has undergone processing in the fourth layer. This TCP segment is composed of a TCP header and data. Here, the TCP header is composed of a basic header (20 bytes) and an optional header. The basic header includes information such as a source port number, destination port number, sequence number, acknowledgment number, code bits and window size. Additionally, the data is composed of actual data and a header added by means of processing of an upper layer equal to or higher than the session layer.

Fig. 13 shows the structure of an IP datagram which is a packet that has undergone processing in the third

layer. This IP datagram is composed of an IP header and
data. Here, the IP header is composed of a basic header
(20 bytes) and an optional header. The basic header
includes information such as a source IP address, a

5   destination IP address, a service type, a packet length,
and a protocol number. Additionally, the data is composed
of actual data and a header of an upper layer (such as TCP,
UDP (User Datagram Protocol) or ICMP (Internet Control
Message Protocol)) including at least one layer equal to or

10   higher than the transport layer.

Fig. 14 shows the structure of a PPP frame which is a
packet that has undergone the processing of the second
layer. The numbers in parentheses in the drawing are given
in units of bytes. This PPP frame consists of a PPP header

15   (5 bytes), data, and a PPP footer (3 or 5 bytes). Here,
the PPP header is composed of various information such as a
flag, address, control, packet protocol identifier (LCP
(Link Control Protocol)), IPCP (Internet Protocol Control
Protocol), IP or IPX (Internetwork Packet Exchange)).

20   Additionally, the data is composed of actual data and a
header (including the above-mentioned TCP header and IP
header) added by processing at a layer including at least
one layer equal to or higher than the network layer. The
PPP footer is composed of an FCS (Frame Check Sequence) and

25   a flag. The MTU indicated in the drawing refers to the
maximum transmission unit.

As described above, on the transmission side, the
actual data to be transmitted is processed by procedures
corresponding to each layer in the OSI layer model from the

30   highest layer to the lowest layer, so that a header
corresponding to the processing of each layer is
sequentially added to the actual data.

In Fig. 7, 7A is a packet that has undergone all of

these processes on the transmission side and finally transmitted, such that, as shown in the drawing, the packet 7A has a header composed of a 5-byte PPP header, a 20-byte IP header and a 20-byte TCP header for a header with a

5   total of 45 bytes added to the head of the application data if it is assumed that there are no optional headers, and a 3- or 5-byte footer added to the tail of the application data. The size of the application data is, for example, 500 bytes and can be expanded to a maximum of 1460 bytes.

10   Next, the operating sequence for the case of performing packet communications according to TCP/IP shall be explained with reference to Fig. 15.

           First, a message requesting set up of the LCP (LCP set up request) is sent from the data transmission side to

15   the data reception side or from the data reception side to the data transmission side (S1). Next, an acknowledgment response message (LCP Set Up Ack) with respect to the LCP set up request is sent from the party receiving the LCP set up request to the other side (S2).

20   Subsequently, a Challenge Message for performing identification at the other side is sent from the data reception side (S3), and upon receipt of this on the data transmission side, a response message is sent out (S4). Then, a Success Message to the effect that the

25   identification on the other side has succeeded is sent out from the data reception side to the data transmission side (S5).

           Once this sequence of operations is completed, an IPCP set up request message is sent from the data reception

30   side to the data transmission side (S6). Furthermore, an IPCP set up request message is sent from the data transmission side to the data reception side (S7).

           Then, an IPCP set up request message or a negative

response message (Nak) is sent from the data reception side
to the data transmission side (S8). Upon receiving this,
an acknowledgment response message with respect to the IPCP
set up request (IPCP Set Up Ack) is sent from the data
5   transmission side (S9).

Then, this time an IPCP set up request message is
sent from the data transmission side to the data reception
side (S10). Upon receiving this, an acknowledgment
response message with respect to this IPCP set up request
10   is sent from the data reception side (S11).

In this way, a PPP link is established between the
data transmission side and the data reception side.

Next, a message (IP + TCP Request) requesting
establishment of an IP data link and establishment of a TCP
15   connection is sent from the data transmission side to the
data reception side (S12). When an acknowledgment response
message with respect to this message is sent from the data
reception side (S13), the data transmission side upon
receiving this sends out an acknowledgment response message
20   to the effect that this acknowledgment response message has
been received (S14).

In this way, a TCP connection is established between
the data transmission side and the data reception side, and
the transmission and reception of actual data is initiated
25   as described below.

First, when packet data is transmitted from the data
transmission side by means of HTTP (HyperText Transfer
Protocol) (S15), the data reception side, upon receiving
this, sends out an acknowledgment response message (S16).
30   Then, in accordance with the size of the data being
transmitted, the operations of steps S15 and S16, i.e. the
operations of transmitting the packets and sending back to
the data transmission source an acknowledgment response

message to the effect that the packets have been received
without problems are repeatedly performed, and the
transmission of the packet data is ultimately completed
(S17).

5   When a message to the effect that the transmission of
the packet data has been completed is sent out from the
data transmission side, the data reception side which has
received this sends out an acknowledgment response message
(S18). Then, this time a message to the effect that the

10   reception of data has been completed is sent out from the
data reception side, upon receipt of which the data
transmission side sends out an acknowledgment response
message. In this way, the TCP session is terminated.

       Next, in disconnecting the PPP link, a message

15   requesting termination of the PPP link (Terminate Request)
is sent out from the data transmission side (S21). Upon
receiving this, an acknowledgment response message is sent
from the data reception side (S22).

       In this way, the TCP link is first disconnected, and

20   upon disconnection of the PPP link, the channel is cut off
(S23) and the overall operation is completed.

       In recent years, mobile communications have spread
widely, and mobile data communications using mobile
terminals should also see a rise in popularity. In the

25   field of mobile data communications, it has become possible
for a user to access the internet using a mobile terminal,
and the provision of user-friendly internet access services
for users has been desired. However, when providing
internet access services using packet communications

30   according to TCP/IP as described above, the problems
mentioned below arise, making them as difficult to handle
as mobile stations (portable telephones), and mobile
terminals capable of readily accessing the internet did not

exist.

First, with TCP/IP, as described above, the header of a packet is added by the layer and encapsulated, as a result of which the overall header size becomes
5 extraordinarily large, and particularly when the actual data size is small, the relative header size becomes large. For example, when transferring about 500 bytes of data during mobile communications, the header size comes to about ten percent of the data size, and there are fields
10 among the information contained in the header which are left absolutely unused in actuality.

Next, there is a problem in that the number of signals exchanged between the data transmission side and reception side is extremely large in the operating
15 sequences during establishment of connections prior to actually transmitting the data. In the example shown in Fig. 15, a total of 14 steps from step S1 to S14 are required. Consequently, as the number of users accessing the network increases, the traffic increases dramatically
20 and the data transfer rate drops.

Additionally, since the user is charged for the operations (steps S1-S14) prior to data transmission and reception, the economic burden on the user side becomes large.
25 Although these problems also occur in connections to the internet via fixed networks, they are especially serious problems in mobile communications wherein the data transmission ability is low in comparison to communications via fixed networks.
30 Additionally, since the TCP/IP is too heavy, it makes the mobile terminals having the ability to rapidly process the TCP/IP larger, heavier, and more expensive than the mobile station, when installing devices with the ability to

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process data to the level of mobile stations. Currently, the large, heavy and expensive mobile terminals which simply integrate a portable computer with a mobile station are received well only in small markets. In contrast,

5 mobile stations are designed with portability, operability and ease of obtainment in mind, and the form and price of mobile stations are believed to be already well-received in an extremely broad market due to their general usefulness and high degree of popularity. Additionally, as mentioned

10 above, various types of content capable of responding to the needs of various users already exist on the internet, and due to the steady increase in the amount of content even now, devices which are capable of being accepted by various users are desired as devices for accessing the

15 internet. Keeping these matters in mind, there is little probability that services for accessing the internet using mobile terminals having the ability to rapidly process TCP/IP will be well-received in a wide market, even without taking into consideration the problem of data transmission

20 ability in mobile communications.

Of course, one might consider having the content providing side develop content which is customized to the data processing power of mobile stations or the data transmission ability of mobile communications, but this

25 type of development of customized content requires a heavy burden of the content providing side, and it is predicted that only a small amount of content with uses that are restricted as compared to the internet will be able to be provided to the user. That is, it is believed that this

30 type of experiment would only be well-received in a small market.

From the above description, it is believed that the foundation of mobile data distribution is in the

combination of mobile stations with the internet, and in order to achieve this combination, it is necessary to develop efficient communication technologies which enable users to stresslessly use content from the internet using

5   mobile stations.

SUMMARY OF THE INVENTION

The present invention has been made in view of the

10 above-mentioned problems, and has the object of providing a communication control method, communication method, server apparatus, terminal device, relay apparatus and communication system capable of efficiently performing data communications even when the data processing ability and

15 transmission ability are not high such as in mobile stations.

In order to achieve the above purpose, a communication control method recited in claim 1 is a communication control method in a relay apparatus for

20 relaying data communications between a server apparatus and a user terminal, comprising a step of receiving a packet containing a message requesting establishment of a connection with the server apparatus and an identification number for the connection sent from the user terminal

25 according to a first communication protocol which is a protocol; a step of transmitting a packet containing an acknowledgment response message that the packet has been received to the user terminal according to the first communication protocol, and establishing a connection

30 between the server apparatus and itself according to a second communication protocol; a step of receiving a packet containing a data transfer request message transmitted from the user terminal to the server apparatus according to the

first communication protocol, and transmitting a packet containing this data transfer request message to the server apparatus according to the second communication protocol; and a step of receiving data transmitted from the server

5   apparatus according to the second communication protocol and transmitting a packet containing this data to the user terminal according to the first communication protocol. Here, the first communication protocol is simpler than the second communication protocol.

10   According to this communication control method, a conversion is made between a communication protocol with a server apparatus and a communication protocol with a user terminal which is simpler than this communication protocol when relaying client/server type data communications

15   between a user terminal and a server apparatus. Consequently, according to this communication control method, at least one of the following is achieved on the user terminal side: a reduction of the header in the packets, a reduction of number of signals exchanged, and a

20   reduction of processing at the user terminal, thereby enabling the load on the user terminal side to be lightened. In particular, since much of the content exchanged over the internet is text data and in the transmission of text data according to TCP/IP, the

25   proportion of actual data in the transmitted packets is low, so that when considering connections to the internet, the reduction of the headers in the packets is extremely effective.

    Additionally, a communication control method recited

30   in claim 2 is a communication control method in a relay apparatus for relaying data communications between a server apparatus and a user terminal, comprising a step of receiving a packet containing a message requesting

establishment of a connection to the server apparatus, an
identification number for the connection and a data
transfer request message for the server apparatus
transmitted from the user terminal according to a first

5 communication protocol; a step of transmitting a packet
containing an acknowledgment response message that the
packet has been received to the user terminal according to
the first communication protocol, establishing a connection
between the server apparatus and itself according to a

10 second communication protocol, and transmitting a packet
containing the data transfer request message to the server
apparatus; and a step of receiving data transmitted from
the server apparatus according to the second communication
protocol and transmitting a packet containing this data to

15 the user terminal according to the first communication
protocol. Here, the first communication protocol is
simpler than the second communication protocol.

According to this communication control method, it is
possible to include a connection establishment request to

20 the server apparatus and a data transfer request in a
single signal from the user terminal to the relay
apparatus. As a result, according to this communication
control method, the traffic between the user terminal and
relay apparatus can be reduced and data transfer requests

25 can be sent out without waiting for acknowledgment response
messages from the relay apparatus at the user terminal, in
addition to the effects of the invention recited in claim
1.

A communication control method recited in claim 3 is

30 a communication control method according to claim 1 or 2,
wherein the number of signals used in establishing the
connection between the user terminal and the relay
apparatus according to the first communication protocol is

less than the number of signals used in establishing the connection between the relay apparatus and the server apparatus according to the second communication protocol.

According to this communication control method, it is
5 possible to reliably reduce the number of signals exchanged by the user terminal when establishing a connection, in addition to the effects due to the invention recited in claim 1 or 2.

A communication control method recited in claim 4 is
10 a communication control method according to claim 1 or 2, wherein a communication interval between the user terminal and the relay apparatus is composed of a radio-oriented interval, and a communication interval between the relay apparatus and the server apparatus is composed of a wire-
15 oriented interval.

According to this communication control method, communications by a communication protocol simpler than the communication protocol in a wired interval are performed in a radio interval which generally has a lower data
20 transmission capacity than the wired interval. Therefore, according to this communication control method, the effect of being able to achieve communications suited to the data transmission capabilities of each interval is obtained in addition to the effects according to the invention recited
25 in claim 1 or 2.

A communication method recited in claim 5 is a communication method for performing data communications between a server apparatus and a user terminal, wherein a communication control procedure in an upper layer
30 containing a transport layer in the data communications comprises a first step of transmitting a first packet containing a message requesting establishment of a connection and an identification number for the connection

from the user terminal to the server apparatus; a second step of transmitting a second packet containing an acknowledgment response message that this first packet has been received from the server apparatus to the user

5 terminal; and a third step of transmitting a third packet containing actual data to the user terminal by designating the identification number from the server apparatus after the connection has been established between the user terminal and the server apparatus.

10   According to this communication method, a connection is established between the user terminal and server apparatus by a communication control procedure of an upper layer containing a transport layer, and the transmission of packets containing actual data is performed through this

15 connection. Consequently, according to this communication method, at least one of the following is achieved on the user terminal side: a reduction of the header in the packets, a reduction of number of signals exchanged and a reduction of processing, thereby enabling the load on the

20 user terminal side to be lightened.

     Here, the reduction of the load on the user terminal side shall be explained in detail.

     For example, a case where the user terminal and server apparatus commence communications using TCP/IP and

25 PPP shall be assumed. In this case, there are the following problems.

1. Since the communication protocols of each layer are for general use, the proportion of actual data contained in the transmitted data is extremely small due to encapsulating in

30 the layers.

2. Since establishment procedures are performed for each layer when establishing a connection, a large number of signals must be exchanged, thus increasing traffic and

causing a great load on the user terminal.

3. At the user terminal, data encapsulating and decapsulating procedures are performed over multiple stages, thus causing a great load on the user terminal.

5   In contrast, by transmitting packets containing actual data through connections established by the communication control procedures of the upper layers containing the transport layer as in this communication method, it is possible to resolve at least one of the above

10   problems.

Additionally, a communication method recited in claim 6 is a communication method for performing data communications between a user terminal and a relay apparatus for relaying data communications between the user

15   terminal and a server apparatus, wherein communication control procedure in an upper layer containing a transport layer in the data communications comprises a first step of transmitting a first packet containing a message requesting establishment of a connection and an identification number

20   for the connection from the user terminal to the relay apparatus; a second step of transmitting a second packet containing an acknowledgment response message that this first packet has been received from the relay apparatus to the user terminal; and a third step of transmitting a third

25   packet containing actual data supplied to the relay apparatus according to a predetermined protocol from the server apparatus to the user terminal by designating the identification number after the connection has been established between the user terminal and the relay

30   apparatus.

According to this communication method, a connection is established between the user terminal and relay apparatus by communication control procedures of upper

layers including the transport layer, and packets
containing actual data from the server apparatus are
transmitted from the relay apparatus to the user terminal
through this connection. Consequently, according to this
5   communication method, the same effects as those of the
invention recited in claim 5 are obtained. Additionally,
according to this communication method, the connection is
established between the user terminal and the relay
apparatus, thereby shortening the time until an
10   acknowledgment response message is received at the user
terminal in comparison to the case where one is established
between the user terminal and server apparatus.

      Also, a communication method recited in claim 7 is a
communication method according to claim 5, wherein in the
15   first step, the user terminal transmits data size
information indicating the maximum size of data that it is
capable of receiving at once to the server apparatus; and
the server apparatus obtains the maximum size from the data
size information which has been received, and divides the
20   actual data for transmission to the user terminal if the
size of the third packet exceeds the maximum size.

      According to this communication method, it is
possible to avoid situations where the server apparatus
sends the user terminal packets of a size which cannot be
25   received at once by the user terminal, in addition to the
effects due to the invention recited in claim 5.

      Furthermore, a communication method recited in claim
8 is a communication method according to claim 6, wherein
in the first step, the user terminal transmits data size
30   information indicating the maximum size of data that it is
capable of receiving at once to the relay apparatus; and
the relay apparatus obtains the maximum size from the data
size information which has been received, and divides the

actual data for transmission to the user terminal if the size of the third packet exceeds the maximum size.

According to this communication method, it is possible to avoid situations where the relay apparatus

5   sends the user terminal packets of a size which cannot be received at once by the user terminal, in addition to the effects due to the invention recited in claim 6.

A server apparatus recited in claim 9 is a server apparatus for performing data communications with a user

10   terminal, comprising communication control means for performing communication control at an upper layer level containing a transport layer when performing the data communications; the communication control means comprising means for receiving a first packet containing a message

15   requesting establishment of a connection and an identification number for the connection transmitted from the user terminal; means for transmitting a second packet containing an acknowledgment response message that this first packet has been received to the user terminal; and

20   means for transmitting a third packet containing actual data to the user terminal by designating the identification number after the connection has been established with the user terminal.

According to this server apparatus, communication

25   control is performed at an upper layer level containing the transport layer. With this communication control, a connection is established between the server apparatus and the user terminal, and packets containing actual data are transmitted from the server apparatus to the user terminal

30   via this connection. Consequently, this server apparatus is able to obtain the same effects as the effects due to the invention recited in claim 5.

A relay apparatus recited in claim 10 is a relay

apparatus for relaying data communications between a server
apparatus and a user terminal, comprising communication
control means for performing communication control at an
upper layer level containing a transport layer when

5   performing the data communications; the communication
control means comprising means for receiving a first packet
containing a message requesting establishment of a
connection and an identification number for the connection
transmitted from the user terminal; means for transmitting

10 to the user terminal a second packet containing an
acknowledgment response message that this first packet has
been received; and means for transmitting a third packet
containing actual data supplied from the server apparatus
to the relay apparatus according to a predetermined

15 protocol to the user terminal by designating the
identification number after the connection has been
established between the user terminal and itself.

   According to this relay apparatus, communication
control is performed at the upper layer level containing

20 the transport layer. With this communication control, a
connection is established between the relay apparatus and
the user terminal, and packets containing actual data from
the server apparatus are transmitted from the relay
apparatus to the user terminal through this connection.

25 Consequently, this relay apparatus is able to obtain the
same effects as the effects due to the invention recited in
claim 6.

   Additionally, a relay apparatus recited in claim 11
is a relay apparatus for relaying data communications

30 between a server apparatus and a user terminal, comprising
means for receiving a packet containing a message
requesting establishment of a connection with the server
apparatus and an identification number for the connection

transmitted from the user terminal according to a first
communication protocol; means for transmitting a packet
containing an acknowledgment response message that the
packet has been received to the user terminal according to

5 the first communication protocol, and establishing a
connection between the server apparatus and itself
according to a second communication protocol; means for
receiving a packet containing a data transfer request
message transmitted from the user terminal to the server

10 apparatus according to the first communication protocol,
and transmitting a packet containing this data transfer
request message to the server apparatus according to the
second communication protocol; and means for receiving data
transmitted from the server apparatus according to the

15 second communication protocol and transmitting a packet
containing this data to the user terminal according to the
first communication protocol; wherein the first
communication protocol is simpler than the second
communication protocol.

20   According to this relay apparatus, a conversion is
made between a communication protocol with a server
apparatus and a communication protocol with a user terminal
which is simpler than this communication protocol when
relaying client/server type data communications between a

25 user terminal and a server apparatus. Consequently, this
relay apparatus able to obtain the same effects as the
invention recited in claim 1.

       Furthermore, a relay apparatus recited in claim 12 is
a relay apparatus for relaying data communications between

30 a server apparatus and a user terminal, comprising means
for receiving a packet containing a message requesting
establishment of a connection to the server apparatus, an
identification number for the connection and a data

transfer request message for the server apparatus
transmitted from the user terminal according to a first
communication protocol; means for transmitting a packet
containing an acknowledgment response message that the

5   packet has been received to the user terminal according to
the first communication protocol, establishing a connection
between the server apparatus and itself according to a
second communication protocol, and transmitting a packet
containing the data transfer request message to the server

10   apparatus; and means for receiving data transmitted from
the server apparatus according to the second communication
protocol and transmitting a packet containing this data to
the user terminal according to the first communication
protocol; wherein the first communication protocol is

15   simpler than the second communication protocol.

        According to this relay apparatus, it is possible to
include a connection establishment request to the server
apparatus and a data transfer request in a single signal
from the user terminal to the relay apparatus. Therefore,

20   this relay apparatus is capable of obtaining the same
effects as the effects of the invention recited in claim 2.

        A relay apparatus recited in claim 13 is a relay
apparatus according claim 11 or 12, wherein the number of
signals used in establishing the connection between the

25   user terminal and the relay apparatus according to the
first communication protocol is less than the number of
signals used in establishing the connection between the
relay apparatus and the server apparatus according to the
second communication protocol.

30   According to this relay apparatus, the number of
signals exchanged at the user terminal when establishing a
connection can be reliably reduced in addition to the
effects of the invention recited in claim 11 or 12.

A relay apparatus recited in claim 14 is a relay apparatus according to any one of claims 10-12, wherein a communication interval between the user terminal and the relay apparatus is composed of a radio-oriented interval,

5 and a communication interval between the relay apparatus and the server apparatus is composed of a wire-oriented interval.

According to this relay apparatus, the communication procedures in a radio interval which generally has a lower

10 data transmission capacity than a wired interval is reduced to less than the communication processes in the wired interval. Consequently, according to this relay apparatus, the effect of being able to achieve communications suited to the data transmission capabilities of each interval is

15 obtained in addition to the effects according to any one of claims 10-12.

A communication system recited in claim 15 is characterized in that a user terminal and a server apparatus are connected via a relay apparatus according to any one of

20 claims 10-12.

According to this communication system, the same effects as the effects of any one of claims 10-12 can be obtained.

A terminal device recited in claim 16 is a terminal

25 device for performing data communications with a server apparatus, comprising communication control means for performing communication control on an upper layer level containing a transport layer when performing the data communications; the communication control means comprising

30 means for transmitting a first packet containing a message requesting establishment of a connection and an identification number for the connection; means for receiving a second packet containing an acknowledgment

response message that the first packet has been received transmitted from the server apparatus; and means for receiving a third packet containing actual data transmitted from the server apparatus by designating the identification

5 number after the connection has been established with the server apparatus.

According to this terminal device, communication control is performed on the upper layer level containing the transport layer. With this communication control, a

10 connection is established between the server apparatus and the terminal device, and packets containing actual data are transmitted from the server apparatus to the terminal device through this connection. Therefore, this terminal device is able to obtain the same effects as the invention

15 recited in claim 5.

The terminal device recited in claim 17 is a terminal device for performing data communications with a server apparatus via a relay apparatus for managing a connection with the terminal device, comprising communication control

20 means for performing communication control on an upper layer level containing a transport layer when performing the data communications; the communication control means comprising means for transmitting a first packet containing a message requesting establishment of a connection with the

25 relay apparatus and an identification number for the connection; means for receiving a second packet containing an acknowledgment response message that the first packet has been received transmitted from the relay apparatus; and means for receiving a third packet containing actual data

30 supplied from the server apparatus to the relay apparatus according to a predetermined protocol and transmitted from the relay apparatus by designating the identification number after the connection has been established between

the relay apparatus and itself.

According to this terminal device, communication control is performed on the upper layer level containing the transport layer. With this communication control, a

5   connection is established between the relay apparatus and the terminal device, and packets containing actual data from the server apparatus are transmitted to the terminal device through this connection. Therefore, this terminal device is able to obtain the same effects as the invention

10   recited in claim 6.

The terminal device recited in claim 18 is a terminal device for performing data communications with a server apparatus via a relay apparatus for managing a connection with the terminal device, comprising means for transmitting

15   a packet containing a message requesting establishment of a connection with the server apparatus and an identification number for the connection according to a first communication protocol; means for receiving a packet containing an acknowledgment response message that the

20   packet has been received transmitted from the relay apparatus according to the first communication protocol; means for transmitting a packet containing a data transfer request message to the server apparatus according to the first communication protocol; and means for receiving

25   according to the first communication protocol a packet containing actual data supplied from the server apparatus to the relay apparatus according to a second communication protocol in response to the data transfer request message. Here, the first communication protocol is simpler than the

30   second communication protocol.

According to this terminal device, a conversion is made at the relay apparatus between a communication protocol with a server apparatus and a communication

protocol with a terminal device which is simpler than this communication protocol when relaying client/server type data communications between a terminal device and a server apparatus. Therefore, this terminal device is able to

5   obtain the same effects as the invention recited in claim 1.

A terminal device recited in claim 19 is a terminal device for performing data communications with a server apparatus via a relay apparatus for managing a connection

10   with the terminal device, comprising means for transmitting according to a first communication protocol a packet containing a message requesting establishment of a connection with the server apparatus, an identification number for the connection and a data transfer request

15   message for the server apparatus; means for receiving a packet containing an acknowledgment response message that this packet has been received transmitted from the relay apparatus according to the first communication protocol; and means for receiving according to the first

20   communication protocol a packet containing actual data supplied from the server apparatus to the relay apparatus according to a second communication protocol in response to the data transfer request message. Here, the first communication protocol is simpler than the second

25   communication protocol.

According to this terminal device, it is possible to include a connection establishment request to the server apparatus and a data transfer request in a single signal from the user terminal to the relay apparatus. Therefore,

30   this terminal device is able to obtain the same effects as the invention recited in claim 2.

A terminal device recited in claim 20 is a terminal device according to claim 18 or 19, wherein the number of

signals used in establishing the connection between the
user terminal and the relay apparatus according to the
first communication protocol is less than the number of
signals used in establishing the connection between the
5   relay apparatus and the server apparatus according to the
second communication protocol.

According to this terminal device, it is possible to
reliably reduce the number of signals exchanged when
establishing a connection in addition to the effects of the
10   invention recited in claim 18 or 19.

A terminal device recited in claim 21 is a terminal
device according to any one of claims 17-19, wherein a
communication interval between the user terminal and the
relay apparatus is composed of a radio-oriented interval,
15   and a communication interval between the relay apparatus
and the server apparatus is composed of a wire-oriented
interval.

According to this terminal device, the communications
procedures in a radio interval which generally has a lower
20   data transmission capacity than a wired interval are
reduced to less than the communication procedures in the
wired interval. Therefore, according to this terminal
device, it is possible to achieve communications suited to
the data transmission capabilities of each interval in
25   addition to the effects of any of claims 17-19.

In summary of the above, the present invention makes
the header size smaller in order to reduce the amount of
data transferred and reduces the number of signals at
channel connection by employing a simplified protocol when
30   performing data communications between a server apparatus
and a user terminal, thereby lightening the traffic and
reducing overhead, and improving the response of data
communications. Therefore, it enables the comfortable use

of internet content using devices having roughly the data processing capabilities of a mobile device and through a communication channel having a low data transmission capacity.

5

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing the structure of a communication system according to an embodiment of the
10   present invention.

Fig. 2 is a diagram showing a protocol structure of the same communication system.

Fig. 3 is a diagram showing another protocol structure of the same communication system.

15   Fig. 4 is a diagram showing the operating sequence prior to packet communications in the same communication system.

Fig. 5 is a diagram showing the operating sequence during packet communications in the same communication
20   system.

Fig. 6 is a diagram showing the operating sequence after packet communications in the same communication system.

Fig. 7 is a diagram comparing the structure of a
25   packet transmitted in TCP/IP communications and the structure of a packet transmitted according to a simplified protocol in the same embodiment.

Fig. 8 is a diagram showing the structure of a packet transmitted in a connection set up request in the same
30   embodiment.

Fig. 9 is a diagram showing the structure of a packet transmitted in acknowledgment response to a connection set up request in the same embodiment.

Fig. 10 is a diagram showing the structure of a packet transmitted during data transmission and reception in the same embodiment, showing the structure of a packet containing actual data and the structure of a packet

5 transmitted in acknowledgment response when a packet containing actual data has been transmitted.

Fig. 11 is a diagram showing an example of the outward appearance of a mobile station contained in the same communication system and a screen of an information

10 display portion when the mobile station is providing the user with information.

Fig. 12 is a diagram showing the format of a TCP segment.

Fig. 13 is a diagram showing the format of an IP

15 datagram.

Fig. 14 is a diagram showing the format of a PPP frame.

Fig. 15 is a diagram showing an operating sequence for the case in which data communications are performed

20 using TCP/IP.

Fig. 16 is a diagram showing the structure of a communication system according to a modification example of the same embodiment.

25   DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferable mode for carrying out the present invention shall be described in detail with reference to the attached drawings.

30

1.   Structure of Embodiment

1.1. System Structure

Fig. 1 shows the structure of a communication network system of the present embodiment.

This communication network system comprises MS (Mobile Station) 1, BS (Base Station) 2, PPM (Packet
5 Processing Module) 3, GWS (GateWay Server) 5, CPS (Content Provider Server) 8 connected to GWS 5 via the internet 6 or a dedicated line 7 and M-SCP (Mobile Service Control Point) 9.

BS 2, PPM 3, GWS 5, M-SCP 9 and the communication
10 lines for connecting these form a mobile packet network 10.

MS 1 is a terminal device which receives packet communication services of the mobile packet communication network 10. In addition to being connected to the mobile packet communication network 10 shown in Fig. 1, the MS 1
15 is connected to a mobile telephone network which is not shown, whereby it is capable of receiving a mobile telephone service.

Fig. 11 shows an example of the outward appearance of the MS 1 and a screen displayed on the MS 1. The MS 1 has
20 an audio input/output portion for the user to perform audio communications, a radio portion for performing radio communications with BS 2 (neither are shown), an information display portion 1a comprising a liquid crystal panel or the like, an operating portion 1b for performing
25 information input operations such as number entry or character input, and an internal microcomputer for controlling these portions. Additionally, MS 1 contains software for viewing document data (a so-called browser). This browser is software for displaying a dialog screen
30 based on data in HTML format (hereafter referred to as HTML data) supplied from the CPS 8 possessed by a content providing business via the mobile packet communication network 10.

The MS 1 displays various types of information on the
information display portion 1a in accordance with the
above-mentioned browser, and provides this information to
the user. This information display portion 1a can display

5   8 (characters) × 6 (lines) of information (it is possible
to have more than 8 characters horizontally and more than 6
lines vertically depending on the area of the display
portion and the character size).

Next, an example of use of the MS 1 shall be

10 explained with reference to Fig. 11.

First, when the user pushes the "information" key on
the operating portion 1b, an initial screen 11A which
provides the user information relating to a weather
forecast is displayed on the information display portion

15 1a. By operating a jog dial key 1c in the center of the MS
1, the user can select a weather forecast menu of "1"-"5"
in the initial screen.

That is, if the user selects "1", a screen 11B
showing today's weather is displayed in the information

20 display portion 1a. If the user selects "2", then a screen
11C showing a weekly weather forecast is displayed on the
information display portion 1a. If the user selects "5",
then a weather message submenu screen 11D is displayed,
from which it is possible to obtain information such as a

25 rainfall alarm or a quick weather report. Furthermore, if
the user selects "6", then a world weather forecast screen
11E is displayed.

In this way, text-based information is displayed on
the information display portion 1a under control of the

30 browser in a form that is easy for the user of the MS 1 to
see.

In Fig. 1, the BS 2 are positioned according to radio
zones which divide the ground e.g. into areas having a

radius of 500 m, and perform radio communications with MS 1
present in these radio zones.

The PPM 3 is a computer system provided in a packet
subscriber switching station accommodating a plurality of
5   BS 2, which receives packet switching requests from the MS
1, and relays packet switching in the mobile packet
communication network 10.

The GWS 5 is a computer system provided with a mobile
packet gateway switching station for interconnecting the
10 mobile packet communication network 10 with another network
such as the internet 6. As shall be explained below, this
GWS 5 is for connecting a radio-oriented interval from the
MS 1 to itself and a wire-oriented interval from itself to
the CPS 8, and performs various types of control to enable
15 packet communications between the MS 1 and CPS 8 by
absorbing differences between the simplified protocol
(hereafter called TL, a first communication protocol) used
in the radio-oriented interval and TCP which is the
protocol in the wire-oriented interval.
20 Additionally, a plurality of the GWS 5 are provided
to form a server group, with a proxy server also contained
in this server group.

The CPS 8 is a server system operated by the content
provider business, and supplies the GWS 5 with the
25 information to be provided to the users in HTML data format
via the internet 6 or a dedicated line 7.

Additionally, the GWS 5 itself contains a server for
the mobile packet communication network 10 business to
provide content.
30 The M-SCP 9 manages subscriber information and
performs processing relating to packet registration when
packet communications begin as shall be explained, and
packet deregistration when packet communications end.

Billing information for the packet communications are recorded in the PPM 3 and the GWS 5, and transferred at a predetermined timing to a call toll accounting center which is not shown.

5

1.2. Protocol Structure

In the above-described communication system, the devices employ the protocol structures described below in order to perform data communications between the MS 1 and
10 CPS 8.

Figs. 2 and 3 express schematically the protocol structure of the present embodiment based on an OSI layer model. Here, Fig. 2 shows a protocol structure for a case where information is received from the CPS 8 by the mobile
15 station alone, and Fig. 3 shows a protocol structure for a case where information is received from the CPS 8 in a structure where an external device 11 such as a portable information terminal or car navigation device is associated therewith.
20 In the protocol structures shown in Figs. 2 and 3, the left side of the GWS 5, i.e. the PPM 3 and MS 1 (and external device 11) are in the radio-oriented data communication interval, wherein a radio communication protocol and the simplified protocol TL of the present
25 embodiment are used. On the other hand, the right side of the GWS 5, i.e. up to the CPS 8 is a wire-oriented communication interval, wherein the general-purpose protocol TCP/IP (second communication protocol) is used.

Thus, the protocol structure shown in Figs. 2 and 3
30 shall be described in sequence from the bottom layers based on an OSI layer model.

1.2.1. First Layer (Physical Layer)

In Figs. 2 and 3, L1 indicates a physical layer.

In the physical layer protocol of the wire-oriented interval, the used frequencies, transmission power, modulation method, access method and the like are defined in order to ensure that the transmission of bit sequences

5   is performed using communication lines composed of physical media such as dedicated lines, public telephone lines or ISDN.

On the other hand, in the physical layer protocol of the radio-oriented interval, the packet communication

10   channels are defined on the basis of the channel structure of the PDC system, and in particular, the arrangement/structure of physical channels for packet communication and the signal coding method and signal transmission method for transmitting signals using the

15   physical channels for packet communication are defined.

1.2.2.   Second Layer (Data Link Layer)

In Figs. 2 and 3, L2 indicates a data link layer.

In the data link layer protocol of the wire-oriented interval, the procedures and interface for performing

20   transparent and highly reliable data transmissions between nodes are defined using bit sequence transmission functions provided in the physical layer. Data links are established using PPP as the protocol of this data link layer.

On the other hand, in the data link layer of the

25   radio-oriented interval, LAPDM (Link Access Procedure for Digital Mobile channel) is used between the MS 1 and PPM 3. This LAPDM is one used for physical control channels and physical communication channels with functions added to perform packet communications efficiently so as to enable

30   use on physical channels for packet communications. Furthermore, in the case of Fig. 3, an LAPB (Link Access Procedure Balanced) is used between the MS 1 and the external device 11.

1.2.3. Third Layer (Network Layer)

The network layer protocol in the wire-oriented interval is composed of an IP (Internet Protocol). This IP performs routing and supplies HTML data transmitted from

5 the CPS 8 to the GWS 5 via the internet 6.

Additionally, in the radio-oriented interval, PMAP (Packet Mobile Application Part) is used between the PPM 3 and GWS 5. This PMAP is defined as a signal format for transmitting and receiving user packets between nodes in a

10 PDC-P network.

The network layer protocol for communications between the MS 1 and PPM 3 is composed of RT (Radio frequency Transmission management), MM (Mobility Management) and CC (Call Control).

15 Here, RT achieves functions relating to management of radio resources (including physical channels for packet communications) including such functions as selection of radio zones and as setting, maintenance, switching and disconnection of radio channels, MM achieves functions

20 relating to mobile station movement support including position registration and identification functions, and CC achieves functions relating to channel call connection control including such functions as setting, maintenance and release of calls. The detailed operations of these are

25 described in "Digital Car Telephone System Standards RCR STD-27F".

These functions work cooperatively to perform such control as simultaneous standby control, communication initiation control, packet transfer control, channel

30 switching control, periodic registration control and communication termination control.

1.2.4. Fourth Layer (Transport Layer)

The transport layer protocol of the wire-oriented

interval is composed of TCP. This is for supplying HTML data transmitted from the CPS 8 to the GWS 5 via the internet 6.

Additionally, the transport layer protocol for
5 communications between the MS 1 and GWS 5 in the radio-oriented interval is composed of the simplified protocol TL. This TL provides a connection-type service for performing highly reliable end-to-end communications, making communications by virtual circuits possible. As a
10 result, higher level applications can provide dialog-type services as if a physical point-to-point link has been established with a communication partner (this is known as a "logical connection"). Additionally, this TL can set up a plurality of logical connections simultaneously. The
15 communication protocol of the mobile packet communication network 10 is composed in such a way that the TL directly resides on the bearer of the mobile packet communication network 10.

1.2.5. Fifth Layer (Session Layer)
20 In the wire-oriented interval, HTTP is used for browser display and SMTP is used for electronic mail distribution on the session layer and presentation layer between the GWS 5 and CPS 8.

Between the MS 1 and GWS 5, communications are
25 performed using HTTP by means of a virtual circuit to be explained below. Additionally, in the application layer, data communications are performed between the MS 1 having a browser and the CPS 8 possessing data of various formats such as plain text, HTML, GIF, and the like.
30 1.2.6. Sixth Layer (Presentation Layer)
Between the MS 1 and GWS 5, the sixth layer is composed of HTTP as an internetwork-dedicated protocol, between the GWS 5 and CPS 8, it is composed of HTTP/SMTP.

1.2.7. Seventh Layer (Application Layer)

The application layer of the MS 1 is composed of a browser having the function of internet browsing software, and the application layer of he CPS 8 which provides the user of the MS 1 with various information is composed of data such as plain text, HTML, GIF, and the like.

2. Operation of the Embodiment

The overall operating sequence of a communication system including the wire-oriented interval and radio-oriented interval employing a protocol structure of this type shall be explained for the case of performing packet communications. In the following description, the structures of the packets exchanged in the radio-oriented intervals shall be referred to as the occasion demands.

2.1. Operating Sequence for Packet Registration

When a user presses the "information" key in MS 1, the operating sequence for packet registration shown in Fig. 4 is executed.

First, a packet communication registration request is issued from the MS 1 side toward the PPM 3 (S100). Upon receiving this, the PPM 3 sends the GWS 5 a signal requesting readout of packet origination information indicating whether or not the packet originator is a packet subscriber (S101). This packet origination information readout request signal is transmitted through the GWS 5 to the M-SCP 9 (S102).

The M-SCP 9 searches for subscriber information corresponding to the originator ID contained in the packet origination information readout request signal to determine whether or not the user of MS 1 is a packet service subscriber, and sends out a packet origination information

readout response signal (S103). Then, this packet
origination information readout response signal is
transmitted through the GWS 5 to the PPM 3 (S104).

   Upon receiving this, the PPM 3 sends the MS 1 a
5 packet identification request signal (S105). A response
signal with respect to this packet identification request
signal is returned from the MS 1 to the PPM 3 (S106).

   Next, a packet communication registration request
signal requesting registration of packet communications is
10 transmitted from the PPM 3 through the GWS 5 to the M-SCP 9
(S107→ S108). The M-SCP 9 performs registration for
initiating packet communication between the MS 1 and the
radio transmission system, and returns a packet
communication registration response signal to the GWS 5
15 (S109). Then, this packet communication registration
request signal is transmitted from the GWS 5 to the PPM 3
(S110).

   Upon receiving this packet communication registration
response signal, the PPM 3 sends a channel connection
20 request signal requesting channel connection to the GWS 5
(S111). Receiving this, the GWS 5 sends a channel
connection request signal to the CPS 8 (S112), and the CPS
8 returns a channel connection response signal (S113).

   Upon receiving the channel connection response
25 signal, the GWS 5 sends the PPM 3 a channel connection
request signal (S114), and the PPM 3 sends the MS 1 a
packet communication registration response signal (S115).

2.2. Operating Sequence during Packet Communications
30   When this sequence of packet communication
registration procedures ends, an initial screen such as
shown in the previously mentioned Fig. 11 is shown in the
information display portion 1a of MS 1. Then, when the

user operates a jog dial key 1c and selects a menu number
from the initial screen, packet communications are
commenced to display the content of the homepage at the URL
linked to that number on the information display portion

5 1a.

Fig. 5 shows the operating sequence during packet
communications.

First, the MS 1 sends out a packet (TL-OpenReq
packet; "first packet" in the claims) containing a

10 connection setup request message (Open Request), the URL of
the homepage which is to be accessed, and an HTTP-Get
method requesting transfer of the data required to display
the content of the homepage on the information display
portion 1a of the MS 1 (S200).

15 Fig. 8 shows the structure of the TL-OpenReq packet
sent when requesting connection setup. In this packet, the
field indicating the type of message contains information
indicating that the message type is an "Open Request"
message, and the field for data contains data for the HTTP-

20 Get method including the above-mentioned URL. The logical
number field contains identification numbers for
identifying the end-to-end connection established between
the MS 1 and GWS 5. The simplified protocol TL in the
radio-oriented interval enables a plurality of simultaneous

25 logical connections, each logical connection being
identified by means of this logical number. This logical
number is set on the mobile station side.

Additionally, the field indicating communication
parameters contains the data length and the number of units

30 of data capable of being received at once by the MS 1, as
well as information such as timer values for the case where
retransmission is to be performed. That is, the MS 1
houses information relating to its own capabilities in the

communication parameter field of the transfer packet to be sent to the network side.

This TL-OpenReq packet is sent through the PPM 3 to the GWS 5 (S201). Upon receiving this, the GWS 5 returns a
5   TCP acknowledgment response packet and a packet containing an acknowledgement response message (Open Acknowledge) with respect to the TL Open Request is returned to the PPM 3 (S202, S203).

That is, on the network side, a logical connection
10   setup request message is received, the communication parameter information for the MS 1 side is analyzed, and the communication parameters at logical connection setup are determined and sent out together with the acknowledgment response message (Open Acknowledge).
15   In this way, with the simplified protocol TL, the capabilities of the partner side (above-mentioned communication parameter values) are negotiated before setting up the logical connection prior to data exchange, so that resources are used efficiently and capacity control
20   is performed by traffic gradients.

Then, a logical connection is established between the MS 1 and the GWS 5 by means of these operations, and the exchange of packet data is completed.

Fig. 9 shows the structure of a TL-OpenAck packet
25   sent as an acknowledgement response to a connection setup request. In this packet, the field indicating the message type contains information indicating that it is an "Open Acknowledge" message, and the logical number field contains logical numbers designated at the time of the connection
30   setup request.

Then, this TL-OpenAck packet is transferred to the mobile station side (S205), and the TCP acknowledgment response packet is transferred from the PPM 3 to the GWS 5

(S204).

On the other hand, the following type of exchange occurs between the GWS 5 which has received the TL-OpenReq packet and the CPS 8 based on the normal TCP operating

5   sequence.

First, in order to establish a connection between the GWS 5 and the CPS 8, a segment to which a SYN flag has been set is sent from the GWS 5 to the CPS 8 (S206), and as an acknowledgment response to indicate that the segment has

10   been received, a segment with an SYN flag and ACK flag is returned from the CPS 8 to the GWS 5 (S207). Then, a segment having an ACK flag is sent from the GWS 5 to the CPS 8 (S208). A connection is established between the GWS 5 and the CP server 8 by means of this Three Way Handshake

15   procedure.

Next, an HTTP-Get segment containing the URL of the target homepage (obtained from MS 1 in step S201) is transmitted from the GWS 5 to the CP server 5 (S209), and the CPS 8 returns an acknowledgment response signal

20   indicating that the segment has been received to the GWS 5 (S210).

Then, an HTTP-Res segment containing data from the homepage in CPS 8 designated by the URL is transmitted from the CPS 8 to the GWS 5 (S211), and a segment with an ACK

25   flag indicating that the segment has been received is returned from the CPS 8 (S212).

When data transfer by the HTTP ends, the following type of connection termination process is performed.

First, a segment set up with a FIN flag is sent from

30   the CPS 8 to the GWS 5 (S213). The GWS 5 returns an acknowledgment response segment indicating that this segment has been received (S214). Then, this time, a similar connection termination process is performed from

the GWS 5 (S215, S216).

By means of this sequence composed of the 11 steps of steps S206-S216, data from the homepage in the CPS 8 is supplied to the GWS 5.

5   Next, a packet (TL-DATA packet) containing data from the homepage in CPS 8 supplied to the GWS 5 is transferred to the PPM 3 (S217).

In Fig. 10, this packet is indicated as packet 10A, and its structure is shown. In this packet 10A, the field

10   indicating the message type contains information indicating that the message type is a "Data" message, and the data field contains the data from the homepage in the CPS 8.

A TCP acknowledgment response packet indicating that this packet has been received is returned from the PPM 3 to

15   the GWS 5 (S218). Then, the TL-DATA packet transferred to the PPM 3 is transferred to the MS 1 (S219). As a result, data from the homepage designated by the user is transferred to the MS 1, and the content corresponding to the number selected from the initial screen by the user is

20   displayed on the information display portion 1a.

Then, the MS 1 returns an acknowledgment response packet (TL-DATA Ack packet) indicating that the TL-DATA packet has been received to the PPM 3 (S220).

In Fig. 10, this packet is shown as packet 10B, and

25   its structure is shown. In this packet 10B, the field indicating the message type contains information indicating that the message type is "Data Acknowledge".

The packet returned to the PPM 3 is transferred to the GWS 5 (S221), and a TCP acknowledgment response packet

30   indicating that this packet has been received is returned to the PPM 3 (S222).

While the example explained above is one wherein data transfer ends after a single packet transfer from the CPS 8

to the MS 1, in actual practice, the sequences between the PPM 3 and GWS 5 (S217, S218, S221, S222) and the sequences between the MS 1 and PPM 3 (S219, S220) are repeatedly performed in accordance with the amount of data supplied

5   from the CPS 8. That is, if the amount of data supplied from the CPS 8 is 3 times the maximum amount of data capable of being received at once on the MS 1 side, then the data is transferred to the MS 1 side in 3 divisions, and the processes of steps S217, S218, S221 and S222, and

10 steps S219 and S220 are performed 3 times.

2.3. Operating Sequence at Packet Communication
Termination

       Fig. 6 shows the operating sequence at the time of

15 packet communication termination.

       First, a signal which requests deregistration from packet communications is transmitted from the MS 1, through the PPM 3 and GWS 5 to the M-SCP 9 (S300 → S301 → S302). The M-SCP 9 deregisters MS 1 from packet communications,

20 and sends a packet communication deregistration signal (S303). This packet communication deregistration signal is transmitted via the GWS 5 and PPM 3 to the MS 1 (S304 → S305), and upon receiving it, the MS 1 sends the PPM 3 a response signal with respect to the packet communications

25 deregistration signal (S306).

       Next, the PPM 3 sends the GWS 5 a signal requesting disconnection of the channel (S307), and the GWS 5 sends the CPS 8 the channel disconnection request signal (S308). Upon receiving this, the CPS 8 sends the GWS 5 a channel

30 disconnection response signal (S309), and the GWS 5 sends the PPM 3 a channel disconnection response signal (S310), thus ending the sequence performed at packet communications termination.

F0276/3026

3.   Effects of the Embodiment

(1)   In this way, by comparing the conventional sequence using PPP, IP and TCP shown in Fig. 15 with the sequence using TL between the MS 1 and GWS 5 shown in Fig. 5 of the present embodiment, it is possible to largely reduce (to about 1/3) the number of signals exchanged between the transmitting side and the receiving side, and to smoothly perform data communications even if the hardware specs (CPU processing power, memory capacity, etc.) of the MS 1 are not very high.

(2)   Additionally, as shown in Fig. 7, the structure of the packet 7B transferred in the present embodiment is considerably simplified. That is, in communications by the simplified protocol TL, each packet is composed of a header of approximately 10 bytes (called the TL header) and application data (e.g. 500 bytes, expandable to a maximum of 1400 bytes). Consequently, the header size is largely reduced (to about 1/5) in comparison to convention packets 7A using TCP/IP. As a result, the amount of transferred data is reduced and the communication cost is also lowered.

4.   Examples of Modifications

The present invention is not restricted to the above-described embodiment, and various modifications such as the examples given below are possible.

(1)   While data communications downstream with respect to the network was described in the present embodiment from the viewpoint of the user of a mobile station receiving data distributions from a CP server, it is also possible to transfer data according to the communication protocol (TL) described in the present embodiment in data communications upstream. That is, data communications by TL are possible

in cases where electronic mail is to be transmitted to a partner terminal connected to the internet.

(2)   The communication protocol (TL) described in the present embodiment is no more than a single example of a

5   simplified protocol. It can be any protocol that does not have a high signal number such as the conventional TCP/IP, is connected to the communication partner by a virtual circuit at the transport layer level, and allows for connection-type communications.

10   (3)   The structure of the packets and content of the information elements described in the present embodiment are only examples, and may be of any type which allows the header size to be made smaller and enables smooth data communications between the user terminal and the relay

15   apparatus.

(4)   The format of the data distributed from the CP server does not need to be HTML, and other formats may be employed. For example, if the distributed information is only text data, then it does not have to be a data format

20   which uses browser-compatible tags such as HTML.

(5)   The GWS 5 can be composed of a plurality of devices, such as to spread the load and traffic on the GWS 5. For example, as shown in Fig. 16, it can be separated into an M-PGW (Mobile Message-Packet Gateway Module) 11 and a GWS

25   13, such that the GWS 13 performs relay processes between the mobile packet communications network 10 and external communication paths, and the M-PGW 12 performs other processes. Additionally, it is possible to provide a plurality of M-PGW 11 and connect each M-PGW 11 to the GWS

30   13, so as to spread the load and traffic on each M-PGW.